Astronomy and Astrophysics 2008 vol.490 N3, pages 1127-1134

Absorption features in the spectra of X-ray bursting neutron stars

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Abstract

Context. The discovery of photospheric absorption lines in XMM-Newton spectra of the X-ray bursting neutron star in EXO0748-676 by Cottam and collaborators allows us to constrain the neutron star mass-radius ratio from the measured gravitational redshift. A radius of R=9-12km for a plausible mass range of M= 1.4-1.8 M⊙ was derived by these authors. Aims. It has been claimed that the absorption features stem from gravitationally redshifted (z=0.35) n=2-3 lines of H- and He-like iron. We investigate this identification and search for alternatives.Methods. We compute LTE and non-LTE neutron-star model atmospheres and detailed synthetic spectra for a wide range of effective temperatures (Teff=1-20MK) and different chemical compositions.Results. We are unable to confirm the identification of the absorption features in the X-ray spectrum of EXO0748-676 as n=2-3 lines of H- and He-like iron (Fe XXVI and Fe XXV). These are subordinate lines that are predicted by our models to be too weak at any Teff. It is more likely that the strongest feature is from the n= 2-3 resonance transition in Fe XXIV with a redshift of Z=0.24. Adopting this value yields a larger neutron star radius, namely R=12-15 km for the mass range M=1.4-1.8 M⊙, favoring a stiff equation-of-state and excluding mass-radius relations based on exotic matter. Combined with an estimate of the stellar radius R>12.5km from the work of Özel and collaborators, the Z=0.24 value provides a minimum neutron-star mass of M>1.48 M⊙, instead of M>1.9M ⊙, when assuming Z=0.35. Conclusions. The current state of line identifications in the neutron star of EXO0748-676 must be regarded as highly uncertain. Our model atmospheres show that lines other than those previously thought must be associated with the observed absorption features. © 2008 ESO.

http://dx.doi.org/10.1051/0004-6361:200810129

Keywords

Line: formation, Line: identification, Scattering, Stars: individual: EXO0748-676, Stars: neutron, X-rays: stars